

The opinion in support of the decision being entered today was *not* written for publication and is *not* binding precedent of the Board.

Paper No. 35

UNITED STATES PATENT AND TRADEMARK OFFICE

BEFORE THE BOARD OF PATENT APPEALS
AND INTERFERENCES

Ex parte GLENN ALLEN BIERY, DANIEL MARK BOYNE,
HORMAZDYAR MINOCHER DALAL, and H. DANIEL SCHNURMANN

Appeal No. 2000-0239
Application No. 08/839,843

ON BRIEF

Before KRASS, DIXON, and BARRY, *Administrative Patent Judges*.
BARRY, *Administrative Patent Judge*.

DECISION ON APPEAL

The examiner rejected claims 1-19. The appellants appeal therefrom under 35 U.S.C. § 134(a). We affirm-in-part.

BACKGROUND

The invention at issue relates to the design of metal interconnections for integrated circuits ("ICs"). The

leaves a void in the interconnection. Growth of the void increases the electrical resistance of the interconnection to a point where the associated IC fails.

The appellants assert that their invention eliminates void growth by "the short-length effect." (Spec. at 2-3.) More specifically, the short-length effect occurs in short aluminum interconnections if an electrical current is supplied through leads of materials in which aluminum diffusivity is low. The physical origin of the short-length effect is the build-up of backstress as aluminum atoms pile up against the diffusion barrier leads; this backstress counteracts the electromigration driving force. A steady-state condition arises in situations where the backstress balances the electromigration driving force. Under this condition, "no further electromigration damage results." (*Id.* at 3.)

The appellants' invention features segments of aluminum

invention can be advantageously enhanced by adding an underlayer, an overlayer or both, all of which are made of refractory metal. The aforementioned structure can be expanded to include vias or studs linking interconnection lines placed at different levels of an IC.

Claim 18, which is representative for present purposes, follows:

18. An interconnection wiring structure of a semiconductor integrated chip for minimizing electromigration, comprising:

an insulated substrate;

sections of high conductivity metal on top of said insulated substrate at a position where the interconnection wiring is to be placed; and

coplanar sections of a diffusion barrier metal interspersed between said sections of high conductivity metal, wherein

said sections of high conductivity metal and diffusion barrier metal are connected to each other to ensure electrical continuity, and wherein said diffusion barrier metal is selected from the group consisting of tantalum containing nitrogen, chromium, chromium/chromium oxide, titanium, titanium nitride,

The prior art applied by the examiner in rejecting the claims follows:

Li et al. ("Li")	5,439,731	Aug. 8, 1995 (filed Mar. 11, 1994)
Drake et al. ("Drake")	4,121,241	Oct. 17, 1978
Saito	JP 1-101653	Apr. 19, 1989. ¹

Claims 1-17 stand rejected under 35 U.S.C. § 102(e) as anticipated by Li. Claims 18 and 19 stand rejected under 35 U.S.C. § 103(a) as obvious over Saito in view of Drake.

OPINION

After considering the record, we are persuaded that the examiner erred in rejecting claims 1-17 but did not err in rejecting claims 18 and 19. Accordingly, we affirm-in-part. Our opinion addresses the following rejections:

- anticipation rejection of claims 1-17
- obviousness rejection of claims 18 and 19.

I. Anticipation Rejection of Claims 1-17

is entitled to the benefit of the filing date of Biery, Li would not be prior art against the instant application. The examiner asserts that the instant application is not entitled to the benefit of Biery's filing date for two reasons.

First, regarding independent claims 1, 3, 6, 10, 12, and 13, he asserts, "it is indeterminable from the disclosure of the patented parent application, whether the claimed 'sublayers' and 'overlayers' extend fully across both the sections (3) and (4) or only across one of sections (3) or (4)." (Examiner's Answer at 8.) The appellants argue, "[i]n col. 5, lines 11-27, it is indicated that in addition to the structure of Figure 1, 'the high conductivity metal (sic) may be comprised of an underlay (i.e., a thin layer of refractory metal lying under the high conductivity metal) or an overlay (i.e., a thin layer of refractory metal placed on top of the high conductivity metal), or both, and underlay and an overlay.'" (Appeal Br. at 24.)

following limitations: "directly on, and in physical contact with, said sublayer: sections of high conductivity metal on said sublayer; and coplanar sections of said diffusion barrier metal interspersed between said sections of high conductivity metal.

. ." Similarly, independent claims 6 and 10 specify in pertinent part the following limitations: "an overlayer of said diffusion barrier metal on said conductive and said diffusion barrier metal sections. . . ." Also similarly, independent claim 12 specifies in pertinent part the following limitations: "an overlayer of said first diffusion barrier metal on said sections of high conductivity and said sections of said second diffusion barrier metal. . . ." Further similarly, independent claim 13 specifies in pertinent part the following limitations: "directly on, and in physical contact with, said sublayer: sections of high conductivity metal interspersed between said protruding sections. . . ." Accordingly, independent claims 1, 3, 6, 10, 12, and 13 require *inter alia* a layer of diffusion barrier metal lying under, lying over, or lying both under and over interspersed

The next inquiry is whether the subject matter is supported by the written description of Biery. "'Although [the applicant] does not have to describe exactly the subject matter claimed, . . . the description must clearly allow persons of ordinary skill in the art to recognize that [he or she] invented what is claimed.'" *Vas-Cath, Inc. v. Mahurkar*, 935 F.2d 1555, 1563, 19 USPQ2d 1111, 1116 (Fed. Cir. 1991) (quoting *In re Gosteli*, 872 F.2d 1008, 1012, 10 USPQ2d 1614, 1618 (Fed. Cir. 1989)). "[T]he test for sufficiency of support . . . is whether the disclosure of the application relied upon 'reasonably conveys to the artisan that the inventor had possession at that time of the later claimed subject matter.'" *Ralston Purina Co. v. Far-Mar-Co, Inc.*, 772 F.2d 1570, 1575, 227 USPQ 177, 179 (Fed. Cir. 1985) (quoting *In re Kaslow*, 707 F.2d 1366, 1375, 217 USPQ 1089, 1096 (Fed. Cir. 1983)). "Application sufficiency under §112, first paragraph, must be judged as of the filing date [of the application]." *Vas-Cath*, 935 F.2d at 1566, 19 USPQ2d at 1119 (citing *United States Steel Corp. v. Phillips Petroleum Co.*, 865

thin layer of refractory metal lying under the high conductivity metal) or an overlay (i.e., a thin layer of refractory metal placed on top of the high conductivity metal), or both, underlay and overlay." Col. 5, ll. 11-16. In view of this disclosure, we are not persuaded that when Biery was filed, the inventors lacked possession of a layer of diffusion barrier metal lying under, lying over, or lying both under and over interspersed sections of a high conductivity metal and a diffusion barrier metal.

Second, the examiner asserts, "the disclosure of the patented parent application fails to provide the manner and process of making and using the 'sublayer' and 'overlayer.'" (Examiner's Answer at 8.) The appellants argue, "one of ordinary skill in the art could have easily constructed Figures 5-7, of the present application from the description of underlays and overlays in the '788 patent." (Appeal Br. at 27.)

"To be enabling under §112, a patent must contain a

USPQ 592, 599 (Fed. Cir. 1983)). "That some experimentation is necessary does not preclude enablement; the amount of experimentation, however, must not be unduly extensive." *Id.* at 1576, 224 USPQ at 413. "[T]he PTO bears an initial burden of setting forth a reasonable explanation as to why it believes that the scope of protection provided by that claim is not adequately enabled by the description of the invention provided in the specification of the application. . . ." *In re Wright*, 999 F.2d 1557, 1561-62, 27 USPQ2d 1510, 1513 (Fed. Cir. 1993) (citing *In re Marzocchi*, 439 F.2d 220, 223-24, 169 USPQ 367, 369-70 (CCPA 1971)).

Regarding a choice of materials, Biery explains that "[t]he CVD tungsten, shown in FIG. 1, acts as the barrier material of choice, but any material in which aluminum diffusivity is small at processing temperatures, such as any of the refractory metals mentioned above, could also be used advantageously." Col. 5, ll. 16-21. The other refractory metals are listed "as molybdenum,

density dependent. The aluminum segment length decreases inversely as the current density increases. The increase in wiring line resistance caused by somewhat higher resistance of the diffusion barrier metal is usually less than 15 percent." Col. 5, ll. 21-26. In view of these explanations and the remainder of the disclosure, we are not persuaded that Biery would not enable one skilled in the art to make and use the claimed invention without undue experimentation.

The examiner fails to show that the instant application is not entitled to the benefit of Biery's filing date. Accordingly, Li is not prior art against the instant application. Therefore, we reverse the rejection of claims 1-17 as anticipated by Li.

II. Obviousness Rejection of Claims 18 and 19

Rather than reiterate the positions of the examiner or appellants *in toto*, we address the two points of contention therebetween. First, the examiner asserts, "it would have been

purpose of enhancing adhesion." (Examiner's Answer at 3.) The appellants argue, "the Examiner has not provided any motivation for a person skilled in the art to take selective teachings from Saito and Drake and make Appellants' invention obvious." (Appeal Br. at 21.)

"`[T]he question is whether there is something in the prior art as a whole to suggest the desirability, and thus the obviousness, of making the combination.'" *In re Beattie*, 974 F.2d 1309, 1311-12, 24 USPQ2d 1040, 1042 (Fed. Cir. 1992) (quoting *Lindemann Maschinenfabrik GMBH v. American Hoist & Derrick Co.*, 730 F.2d 1452, 1462, 221 USPQ 481, 488 (Fed. Cir. 1984)). "[E]vidence of a suggestion, teaching, or motivation to combine may flow from the prior art references themselves, the knowledge of one of ordinary skill in the art, or, in some cases, from the nature of the problem to be solved. . . ." *In re Dembiczak*, 175 F.3d 994, 999, 50 USPQ2d 1614, 1617 (Fed. Cir. 1999) (citing *Pro-Mold & Tool Co. v. Great Lakes Plastics, Inc.*,

Here, "[t]he objective of [Saito] is to offer a semiconductor device whereby migration is prevented and the reliability of the aluminum wiring is improved." Saito Translation, p. 2. Toward that objective, the reference discloses an embodiment of its invention wherein "the aluminum wiring is divided into sections by the tungsten layer (14). . . ." *Id.* at 3. Although Saito describes the tungsten layer, it invites the use of other materials. Specifically, "it goes without saying that other materials such as titanium, molybdenum, and the like may be used." *Id.* at 5.

For its part, Drake discloses that using titanium "as a barrier layer," col. 5, l. 1, is desirable for several reasons. Among these reasons is the prevention of electromigration. Specifically, "[i]t has been found that the described structure and method improved the electromigration resistance of the second aluminum layer 44 because of the presence of the titanium layer 42." *Id.* at 11. 24-26. Other advantages include

and "reduc[ing] the surface area required for metalization."
Col. 6, ll. 1-2. Because using the titanium barrier material of Drake to form the layer of Saito's embodiment would have offered these advantages, we are persuaded that the prior art as a whole would have suggested combining the teachings of the references.

Second, the examiner asserts, "Drake et al. teach (col. 4, line 66 to col. 5, line 10) the use of a titanium barrier metal layer formed between adjacent aluminum layers for the purpose of prohibiting interdiffusion and for the additional purpose of enhancing adhesion." The appellants argue, "*Appellants' amended Claim 18*, clearly states that the *diffusion barrier metal* is selected from the group consisting of tantalum containing nitrogen, chromium, chromium/chromium oxide, titanium, titanium nitride, titanium-tungsten, hafnium, and any combination thereof, and *this is neither taught nor disclosed by Saito and/or Drake.*" (Appeal Br. at 20.)

1993) (citing *In re Zletz*, 893 F.2d 319, 321, 13 USPQ2d 1320, 1322 (Fed. Cir. 1989)).²

Here, independent claim 18 specifies in pertinent part the following limitations: "said diffusion barrier metal is selected from the group consisting of tantalum containing nitrogen, chromium, chromium/chromium oxide, titanium, titanium nitride, titanium-tungsten, hafnium, and any combination thereof." Giving the claim its broadest reasonable interpretation, the limitations merely require *inter alia* a titanium diffusion barrier. The claim does not require the other materials, e.g., nitrogen, chromium, chromium/chromium oxide, etc.

² "The PTO broadly interprets claims during examination of a patent application since the applicant may 'amend his claims to obtain protection commensurate with his actual contribution to the art.'" *In re Yamamoto*, 740 F.2d 1569, 1571, 222 USPQ 934, 936 (Fed. Cir. 1984) (quoting *In re Prater*, 415 F.2d 1393,

Having determined what subject matter is being claimed, the next inquiry is whether the subject matter is obvious. "'A *prima facie* case of obviousness is established when the teachings from the prior art itself would appear to have suggested the claimed subject matter to a person of ordinary skill in the art.'" *In re Bell*, 991 F.2d 781, 783, 26 USPQ2d 1529, 1531 (Fed. Cir. 1993) (quoting *In re Rinehart*, 531 F.2d 1048, 1051, 189 USPQ 143, 147 (CCPA 1976)). Furthermore, "[n]on-obviousness cannot be established by attacking references individually where the rejection is based upon the teachings of a combination of references." *In re Merck & Co.*, 800 F.2d 1091, 1097, 231 USPQ 375, 380 (Fed. Cir. 1986) (citing *In re Keller*, 642 F.2d 413, 425, 208 USPQ 871, 881 (CCPA 1981)).

Here, the rejection is based on a combination of Saito and Drake. As explained regarding the first point of contention, Saito teaches that materials such as titanium may be used for its layer 14. As also explained regarding the first point of

18 and of claim 19, which depends therefrom, as obvious over Saito in view of Drake.

Although the examiner rejected only claims 18 and 19 as obvious over Saito in view of Drake, we cannot help but notice the similarity of claims 1-17 thereto. Accordingly, the examiner and appellants might wish to reassess the patentability of these claim in view of the combined teachings of Saito and Drake.

CONCLUSION

In summary, the rejection of claims 1-17 under 35 U.S.C. § 102(e) is reversed. The rejection of claims 18 and 19 under 35 U.S.C. § 103(a), however, is affirmed. Our affirmance is based only on the arguments made in the brief. Arguments not made therein are neither before us nor at issue but are considered waived.

No time for taking any action connected with this appeal may

AFFIRMED-IN-PART



ERROL A. KRASS)	
Administrative Patent Judge)	
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)	BOARD OF PATENT
JOSEPH L. DIXON)	APPEALS
Administrative Patent Judge)	AND
)	INTERFERENCES
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Appeal No. 2000-0239
Application No. 08/839,843

Page 18

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